CLAIMS

1. A spectrometer, comprising:

an array of illumination sources positioned to illuminate a detection area with a plurality of beams of light,

a detector responsive to the detection area, and

a spectroscopic signal output responsive to relative amounts of light from the beams in different spectral regions received by the detector after interaction with the sample in the detection area.

2. The apparatus of claim 1 further including a switching array having a plurality of switched outputs that are each operatively connected to an input of at least one of the illumination sources.

3. The apparatus of claim 2 further including at least a first spectrally selective element having and at least a second spectrally selective element, wherein the first spectrally selective element has a different spectral response than does the second spectrally selective element, and wherein the first spectrally selective element is located in an optical path between the detector and a one of the illumination sources that is operatively connected to a first of the switched outputs and the second spectrally selective element is located in an optical path between the detector and a one of the illumination sources that is operatively connected to a second of the switched outputs.

4. The apparatus of claim 3 wherein the spectral responses of the spectrally selective elements correspond to different absorption bands of a predetermined substance.

5. The apparatus of claim 2 wherein the switching array is operative to define an intensity level for one or more of the sources.

6. The apparatus of claim 5 wherein the switching array is operative to define an intensity level for one or more of the sources by determining an illumination time period

for the one of the sources relative to an illumination time period for another of the sources.

7. The apparatus of claim 2 further including sequencing logic operative to cause the switching array to switch the sources in a sequence of successive overlapping spatial patterns.

8. The apparatus of claim 7 wherein the sequencing logic is operative to cause the switching array to switch the sources in a Hadamard sequence.

9. The apparatus of claim 1 further including a plurality of spectrally selective elements having different spectral responses and each being located in an optical path between at least one of the illumination sources and the detector.

10. The apparatus of claim 9 wherein the spectrally selective elements are passive.

11. The apparatus of claim 9 wherein the spectrally selective elements are reflectors.

12. The apparatus of claim 11 wherein the reflectors are at least generally parabolic.

13. The apparatus of claim 11 wherein the reflectors are at least generally ellipsoidal.

14. The apparatus of claim 1 wherein the sources are substantially the same.

15. The apparatus of claim 1 wherein the sources are of a same type.

16. The apparatus of claim 1 wherein the spectrometer is a microscopic instrument and wherein the sources each produce a luminous flux of at most about 10 millilumens lumens at the detection area.

17. The apparatus of claim 1 wherein the spectrometer is a macroscopic instrument and wherein the sources each produce a luminous flux of at most about 1 lumen at the detection area.

18. The apparatus of claim 1 wherein the sources are placed within 2 cm of the detection area.

19. The apparatus of claim 1 wherein the sources are placed within 1 cm of the detection area.

20. The apparatus of claim 1 wherein the sources have a nominal supply voltage of five volts or less.

21. The apparatus of claim 1 wherein the sources have a nominal supply voltage of twelve volts or less.

22. The apparatus of claim 1 wherein the sources are broadband sources.

23. The apparatus of claim 22 further including a plurality of narrow-band dielectric filter elements each located in a optical output path of at least one of the sources.

24. The apparatus of claim 1 wherein the sources are broadband infrared sources.

25. The apparatus of claim 1 wherein the sources are incandescent sources.

26. The apparatus of claim 1 wherein the sources are narrow-band sources.

27. The apparatus of claim 1 wherein the sources are narrow-band infrared sources.

28. The apparatus of claim 1 wherein the sources are constructed from bulk semiconductor materials.

29. The apparatus of claim 1 wherein at least a plurality of the sources are operatively connected to a single power supply.

30. The apparatus of claim 1 wherein the illumination sources are positioned to illuminate different sub-areas of the detection area.

31. The apparatus of claim 1 wherein at least a first portion of the beams overlap within the sample area.

32. The apparatus of claim 1 wherein the detector is located to receive the beams from the illumination sources after they are reflected off of the sample.

33. The apparatus of claim 1 wherein the detector is a multi-element detector array.

34. The apparatus of claim 1 further including a circular support for the array, and wherein the detection area is located along a central axis of the circular support.

35. The apparatus of claim 34 wherein the circular support surrounds an optical path from the detection area to the detector.

36. The apparatus of claim 35 wherein the detector is part of a microscope.

37. The apparatus of claim 1 further including a spectral matching module responsive to the spectroscopic signal output and operative to perform spectral matching operations with one or more known substances.

38. The apparatus of claim 1 wherein the detector includes a plurality of detector elements, wherein the detection area is divided into a plurality of detection sub-areas, and wherein each of the detector elements is aligned with one of the detection sub-areas.

39. The apparatus of claim 38 wherein the detector is an array detector that includes at least the detector elements disposed in an array, further comprising a plurality of optical conductors each including first and second ends, wherein each of the first ends is responsive to at least one of the detection sub-areas, and wherein each of the detector elements is responsive to one of the second ends of at least one of the optical conductors.

40. The apparatus of claim 1 wherein the array includes a plurality of substantially similar illumination sources.

41. A spectrometry method, comprising:

illuminating a sample with a plurality of beams of light,

detecting illumination from the sample resulting from the step of illuminating, and

deriving a spectroscopic signal from relative amounts of the light from the beams detected by the step of detecting in different spectral regions.

42. The method of claim 41 wherein the step of illuminating includes the step of first illuminating the sample with at least a first of the beams and the step of then illuminating the sample with at least a second of the beams.

43. The method of claim 42 further including filtering the first plurality of the beams with a first filter characteristic and filtering the second plurality of the beams with a second filter characteristic, and wherein the first and second filter characteristics are different.

44. The method of claim 43 wherein the steps of illuminating the sample with first and second beams are performed for different beam energies.

45. The method of claim 43 wherein the steps of illuminating the sample with first and second beams are performed for different amounts of time to achieve the different beam energies.

46. The method of claim 41 further including the step of filtering ones of the plurality beams of light according to different filter characteristics.

47. The method of claim 41 further including the step of concentrating the beams.

48. The method of claim 47 wherein the step of concentrating includes a step of collimating.

49. The method of claim 47 wherein the step of concentrating includes a step of focusing.

50. The method of claim 41 further including the step of matching results of the step of deriving with known spectra.

51. The method of claim 41 wherein the step of detecting detects a spatially resolved image and further including the step of evaluating the spatially resolved image to determine composition distribution within at least a portion of the sample.

52. The method of claim 51 wherein the steps of illuminating, detecting, deriving, and evaluating are performed for pharmaceutical dosage units.

53. The method of claim 51 wherein the steps of illuminating, detecting, deriving, and evaluating are performed for pathology samples.

54. The method of claim 51 wherein the steps of illuminating, detecting, deriving, and evaluating are performed for biological tissue.

55. The method of claim 41 wherein the steps of illuminating, detecting, and deriving are performed for pathology samples.

56. The method of claim 41 wherein the steps of illuminating, detecting, and deriving are performed for biological tissue.

57. The method of claim 41 wherein the step of illuminating employs a plurality of substantially similar beams of light.

58. A spectrometer, comprising:

means for illuminating a sample with a plurality of beams of light,

means for detecting illumination from the sample resulting from the means for illuminating, and

means for deriving a spectroscopic signal from relative amounts of the light from the beams detected by the means for detecting in different spectral regions.

59. An optical instrument, comprising:

a plurality of optical conductors each including first and second ends, wherein each of the first ends is responsive to at least one of a plurality of detection sub-areas, and

an array detector including a plurality of array detector elements that are each responsive to one of the second ends of one of the optical conductors.

60. The apparatus of claim 59 wherein the optical conductors are optical fibers.

61. The apparatus of claim 59 wherein the array detector is a two-dimensional array.

62. An optical method, comprising:

receiving light from a plurality of sample sub-areas,

conducting the light received in the step of receiving through a plurality of optically conductive paths, and

detecting the light from the optically conductive paths with different detector elements in a detector array.

63. An optical instrument, comprising:

means for receiving light from a plurality of sample sub-areas,

means for conducting the light received in the step of receiving through a plurality of optically conductive paths, and

detector array means for detecting the light from the optically conductive paths with different detector elements in the detector array.

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